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THE GIRDLES AND HIND LIMB OF HOLOSAURUS ABRUPTUS MARSH

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The specimen described below, in the Paleontological Collection of the University of Chicago, was collected during the summer of 1903 by a University of Chicago paleontological expedition. The complete skeleton was discovered by Dr. E. B. Branson and collected by himself and Professor Williston. Thanks are due to Dr. Williston for permission to study this excellent specimen.

The specimen is of peculiar interest in that it is probably the most complete one of a mosasaur ever collected, almost every bone lying in its original position with relation to the rest of the skeleton. Furthermore, it belongs to the hitherto very imperfectly known form of *Holosaurus abruptus* Marsh, and the undisturbed condition of the skeleton offers an opportunity for clearing up a number of doubtful points. Besides this remarkable specimen, a complete pelvic girdle of the same species was found at the same time, with the bones spread out in their original relations to one another. From the study of these two specimens it was determined: (1) that the ilium lay below the third pygal vertebra, and not below the first, as usually figured, and that it had a nearly vertical position to the vertebral column, instead of having a strong backward slope; (2) that there was a firm symphysis of both the ischia and of the pubes, as shown by the position of these bones (Fig. 2); (3) that there was an interclavicle bone present (Fig. 1). The rear paddle of the mosasaur, moreover, has so far been very imperfectly known. It was figured by Marsh in 1880 for *Platecarpus*, and by Osborn much later for *Tylosaurus dyspelor*, but neither specimen was perfect, and both are of species different from that described below (Fig. 3).

The pectoral girdle of this specimen is very perfectly preserved (Fig. 1). Lying between the coracoids there was found a thin,

bladeliike bone, the interclavicle. In 1880 Marsh¹ stated: "In *Holosaurus* there appears to have been a partially ossified mesosternum;" and in 1889 Dollo² mentioned the presence of an interclavicle

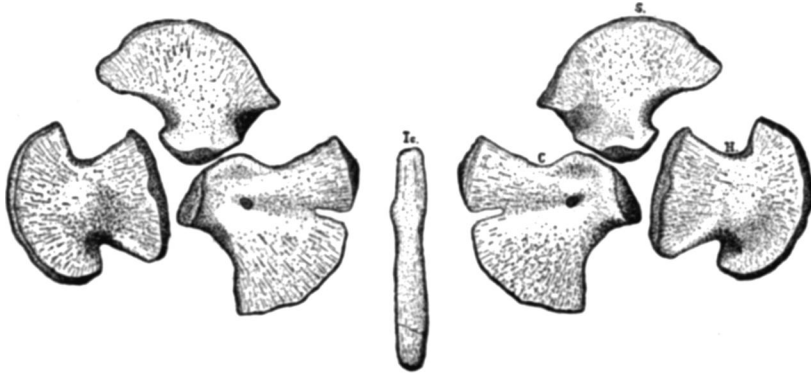


FIG. 1.—Pectoral girdle of *Holosaurus abruptus*. One-seventh natural size. *Ic*, interclavicle; *c*, coracoid; *s*, scapula; *H*, humerus.

in *Plioplatecarpus*. Williston³ discovered the existence of this element in *Platecarpus* in 1899, but up to the present time it has never been figured. The interclavicle in this specimen is slender, rounded

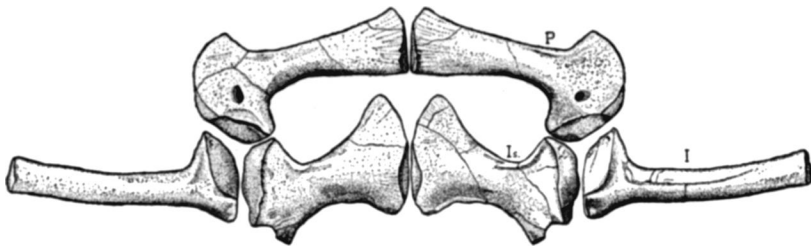


FIG. 2.—Pelvic girdle of *Holosaurus abruptus*. One-sixth natural size. *P*, pubis; *Is*, ischium; *I*, ilium.

laterally at both ends, and differs from that described for *Platecarpus* in that it has no apparent articular facets at the anterior end.

The calcified sternum of the specimen is preserved in the chalk, but no description of this will be attempted in the present article, as

¹ *American Journal of Science*, Vol. XIX (1880), p. 841.

² *Bull. Soc. Belg. Geol. Pal. Hyd.*, III (1889), 286.

³ *Kansas University Quarterly*, Vol. VIII, No. I (January, 1899), p. 39.

considerable further study will be necessary for the proper working-out of this portion of the skeleton.

The *scapula* resembles very closely that of *Platecarpus ictericus*,¹ being thinned and flattened above, with a truncate margin for cartilaginous attachment. Below, the bone is thickened for articulation with the coracoid and humerus.

The *coracoid* also is remarkably like that of *Platecarpus*, the only essential difference being the less deep emargination. This species is referred with great certainty to *Holosaurus abruptus* by Williston after a careful examination of the type specimen in the Yale collection—a specimen which he himself collected. The emargination of the coracoid is therefore proven to be an individual, and not a generic character. The close resemblance of the different elements of the skeleton to that of *Platecarpus* make it seem certain that this specimen must ultimately be referred to that genus, but there are a number of differences between this specimen and any described species of *Platecarpus*. The name *Holosaurus abruptus* will therefore be used provisionally until the specimen is mounted and available for critical comparison.

The ilium.—The ilium is a shaftlike bone, expanded proximally. From the relation in which the bones of the two sides were found it is evident that the vertebral end was approximated in life to the end of the transverse process of the third pygal vertebra, though evidently not attached to it. The relations of the bones, as found, also show that the ilium had a nearly vertical position. Proximally the bone is expanded and thickened, with a continuous facet for articulation with the ischium and pubis, and for the acetabulum. The bone resembles most closely that of *Platecarpus*.

The ischium.—The ischium is a very broad, flat bone, laterally expanded at either end. The acetabular end has facets for articulation with the ilium and pubis, and an outwardly directed face for the acetabulum. Behind the acetabulum, and slightly separated from it, is a thin process with a roughened end for cartilaginous attachment. The shaft of the bone has a rounded, thickened ridge on its lower side, and is slightly concave above. The distal end has a very broad, thin lateral expansion in front. The shaft, at its thickened portion,

¹ *University Geological Survey of Kansas*, Vol. IV, p. 184.

shows a sub-triangular facet for a firm symphysis with the opposite ischium.

The pubis is much like that of *Platecarpus*. It is a thin bone, broadly rounded at the acetabular end, the posterior edge of which ends in facets for the acetabulum, and for articulation with the ilium and ischium. The pubic foramen is placed similarly to that of *Platecarpus*. The lower end of the bone is thin and somewhat expanded, and shows a roughened face for symphysis with the opposite pubis.

Femur.—The femur is a heavy, stout bone, somewhat expanded proximally and terminating along the whole upper border in an articular face which is thickened anteriorly and thinned posteriorly. The trochanter, on the anterior side, is directed upward and inward. The distal end of the bone is more expanded than the proximal, and has a much thickened oval face for articulation with the tibia, and a thinner one for the fibula.

Tibia.—The tibia is a short, stout bone, expanded and much thickened at the proximal end, and having a large, oval face for articulation with the femur. The anterior margin of the bone is deeply concave, and the posterior margin is longer, and less deeply concave. The distal end is fan-shaped, thinned anteriorly and posteriorly, and thickened centrally. It ends in a flat facet for articulation with the large tibial tarsal bone.

In Plate VII of Williston's work on the Mosasaurs,¹ Figs. 1 and 2 are referred to the radius of a doubtful species of *Platecarpus*, but these bones are doubtless tibiae of *Holosaurus abruptus*, to which genus they have already been referred by Williston.

Fibula.—The fibula is a thin, flat bone, expanded laterally at both ends. At the proximal end is the articulation for the femur, facing forward and upward. The anterior margin of the bone is concave throughout and is shorter than the strongly concave posterior margin. Distally the bone is fan-shaped, and bears articular faces for the two upper tarsals.

Tarsus.—The tarsus is composed of three bones, a large and two smaller, posterior to it, all of which are thin and flat. The large bone has two articular faces above, for the tibia and fibula, that for the

¹ *University Geological Survey of Kansas*, Vol. IV, Plate LVII.

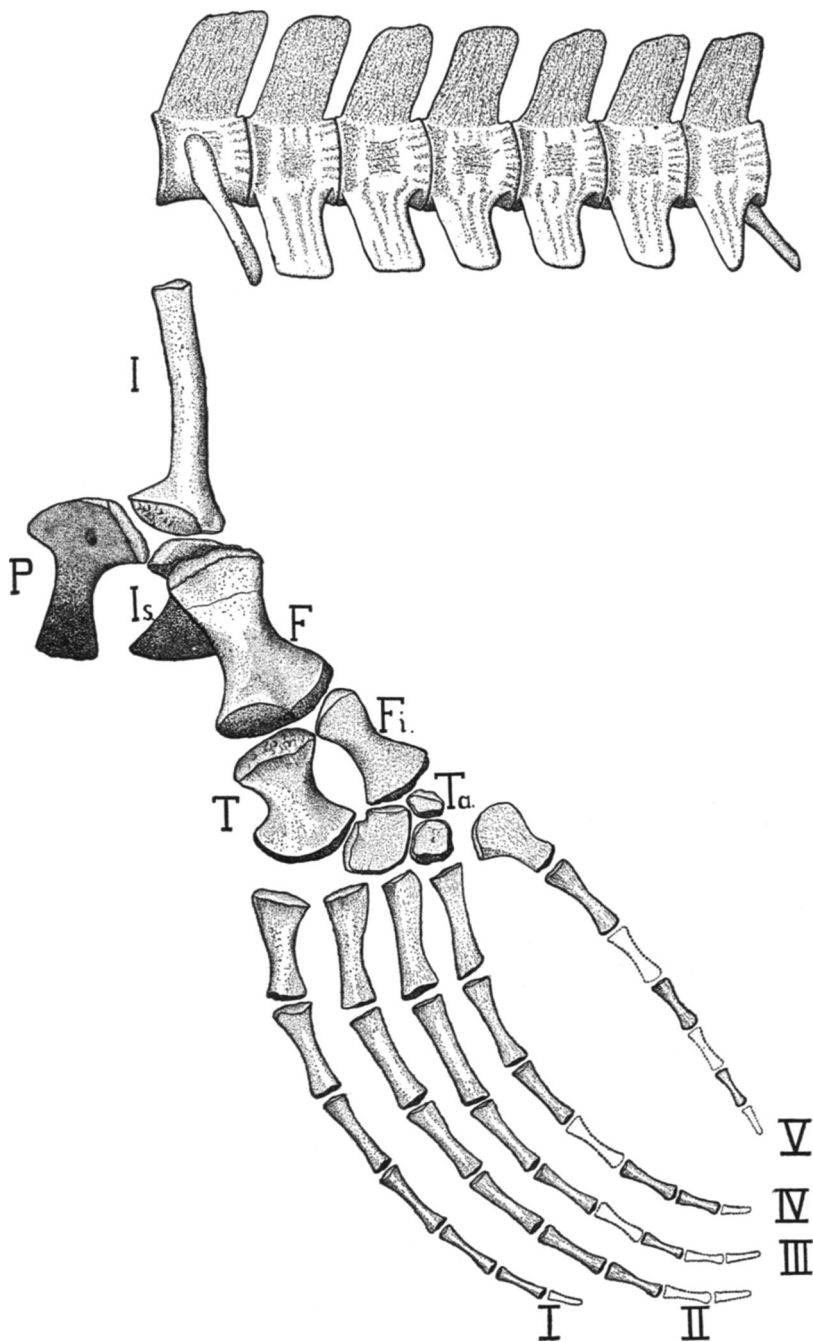


FIG. 3.—Hind limb of *Holosaurus abruptus*. One-fifth natural size. *I*, ilium; *P*, pubis; *Is*, ischium; *F*, femur; *T*, tibia; *Fi*, fibula; *Ta*, tarsus. Ilium found lying opposite the third pygal, the fourth vertebra of the series, as figured.

former sloping obliquely forward, and for the fibula obliquely backward, the two making an angle of something more than 90° . These two faces are separated by a rounded notch. The distal edge is a wide curve, and articulates with the second and third metatarsals and the other two tarsals. The two smaller tarsals lie one above the other, behind the large one. The upper one is the smallest, and articulates with the fibula, the other two tarsals, and the fifth metatarsal. The lower of the two smaller tarsals articulates with the other two tarsals, and with the fourth and fifth metatarsals.

Metatarsals.—The first metatarsal is a stout bone, broadly expanded and thickened proximally, with a large, flat surface for the tibial articulation. This face slopes obliquely backward. Toward the middle the bone is constricted, and the posterior margin is deeply concave, and is shorter than the more gently concave anterior margin. The distal end is slightly expanded and ends in a suboval, flat articular facet.

The second metatarsal is more slender than the first. Its proximal end is expanded laterally, with the anterior edge thicker than the posterior. The articular face is directed forward and upward. The anterior margin of the shaft is thick and only slightly concave, while the posterior margin is thinner and rather deeply concave in the center. The distal end is slightly expanded, and has a subtriangular articular face.

The third metatarsal is the longest of the five. Its somewhat expanded proximal end terminates in a suboval face for articulation with the largest tarsal bone. The anterior margin of the shaft is almost straight, while the posterior margin is deeply convex toward the distal end, which terminates in a backward sloping articular face. The two articular faces are subparallel.

The fourth metatarsal is smaller and more slender than the three preceding. Its proximal articulation slopes forward somewhat, and is subparallel with the backward-sloping distal articular face. The bone is somewhat expanded at both ends, and the concavity of the forward margin, though slight, exceeds that of the nearly straight posterior margin.

The fifth metatarsal is a thin, flattened bone, much expanded proximally. The proximal border is edged on the forward and

upper side, by a flat face for articulation with the two smaller tarsals. The inner border is thicker and less strongly concave than the shorter outer border. Distally, the bone is not one-half the width of the proximal end. It is somewhat thickened, and terminates in a convex articular face.

Phalanges.—The first finger has at least six, possibly seven, phalanges, all stout and of a slender hourglass shape. The inner margin has the greater concavity.

The second finger has seven phalanges, shaped much like those of the first finger, with the greater concavity on the posterior margin.

The third finger is of about equal length with the second, and probably had the same number of phalanges, but the bones are somewhat more slender. The posterior margin is more concave and shorter than the anterior.

The fourth finger has about six phalanges which were somewhat thinner and flatter than in the first three fingers. The greater marginal concavity is on the posterior side.

The fifth finger is thin and flat. There were five or six phalanges, all much wider than thick, with the greater concavity on the anterior side. This finger is considerably shorter than any of the others.

The bones of the hind limbs were somewhat intermingled, and partially disarranged, but a careful study of their positions as found in the chalk slab renders any other arrangement than the one given for all save the terminal bones practically impossible.